ADMINISTRATIVE INFORMATION

1. **Project Name:** Advanced Wireless Sensors for the Industries of the Future

2. **Lead Organization:** Oak Ridge National Laboratory
PO Box 2008, MS 6006
Oak Ridge, TN 37831

3. **Principal Investigator:** Wayne W. Manges
865-574-8529
mangesww@ornl.gov

4. **Project Partners:** None

5. **Date Project Initiated:** April 1, 2003

6. **Expected Completion Date:** September 30, 2005

PROJECT RATIONALE AND STRATEGY

7. **Project Objective:** The project goal is to facilitate the deployment of wireless technology to the industries represented by DOE's Industrial Technology Program IOFs. This project includes the commissioning of the DOE Extreme Measurement Communications Center (EMC2) at ORNL to characterize and simulate the performance of candidate industrial wireless telemetry devices in harsh industrial environments.

8. **Technical Barrier(s) Being Addressed:** The National Research Council has identified advanced wireless sensors as a key research need for the DOE/ITP Industries of the Future. ORNL's previous project ended with feasibility demonstrations at various industrial sites around the nation. Further work is needed however to meet the goals identified in the NRC study sited above:

    1) eliminate interference from metal structures in the manufacturing environment
    2) use intelligent integrated sensors
    3) develop reliable wireless networks for process monitoring and control
    4) develop remote power systems for wireless devices
    5) standardize communication protocols, interfaces, and software.

    VDC's (Venture Development Corporation) recently completed their market analysis: "The North American Market for Wireless Monitoring and Control in Discrete and Process Manufacturing Applications" where they identified reasons why some vendors have chosen not to deploy wireless. "...the three reasons most cited for not using nor planning to use wireless technology were-their customers are not requesting it (by OEMs & systems integrators), the unproven reliability of wireless technology for their type of operations, and the unproven immunity to RF interference

9. **Project Pathway:** Our approach is to demonstrate to end users, suppliers, and to technology experts that the critical issues are being addressed in order to help bring advanced wireless sensors and networks to the IOFs. We help develop or improve existing standards in industrial wireless networks to include measurement, verification and reliability of network and device parameters

We formalize the testing of industrial wireless networks to quantify the latency, throughput, security and fault- tolerance (Interference and Noise).

10. **Critical Technical Metrics:** Development of standards, testing and verification methodologies to be used by the end-user community and critical to the successful deployment of viable wireless technology in the heavy industries characterized by DOE's IOFs.

PROJECT PLANS AND PROGRESS

11. **Past Accomplishments:**
Assisted in Wireless Technology Solicitation: ORNL supported DOE's Gideon Varga in facilitating teaming, assuring high quality proposals, and reviewing and facilitating reviews of submitted proposals. Awards made by DOE to teams led by Honeywell, Eaton, and GE in October 2003 ended this phase of ORNL's support to the solicitation.

12. **Future Plans**:

- Coordination and Integration of Award Team: ORNL continues to support the three teams receiving awards under the DOE Sensors and Automation Crosscut sub-program. ORNL hosts meetings and teleconferences to facilitate communication among the teams to reduce redundancy, improve open standards utilization, and optimize the DOE investment in moving wireless technology into the marketplace. ORNL is tasked to provide underlying, non-competitive, "background" technology, as required, for the teams. The planned completion of this task is 9/30/05.

- Facilitate Formation of WINA: The Wireless Industrial Networking Alliance was started under DOE guidance in April 2003. ORNL supports DOE in helping WINA move to self-sufficiency while continuing to address DOE's needs in assuring the deployment of wireless technology for improving energy efficiency, reducing emissions, and improving US industry competitiveness. WINA now has a board of directors as well as technical and marketing sub-committees. Industry leaders now recognize WINA as an important voice for the end-user community and critical to the successful deployment of viable wireless technology in the heavy industries characterized by DOE's IOFs. The planned completion of this task is 9/30/04.

- Extreme Measurement Communications Center (EMC^2): The DOE Extreme Measurement Communications Center, located at ORNL, is being assembled to assure that the candidate wireless technologies being considered for deployment in US industries are suitable in robustness, latency, throughput, and security. The Center is being stocked with high-tech measurement, testing, and simulation equipment to allow users to verify the performance of candidate devices comparing them with their own specifications as well as with emerging and existing standards. Portable instruments allow researchers to do field tests as well as confirming laboratory outcomes. Currently an alliance is being formed with the center with WINA and member companies for technology assessment and characterization. The center also currently provides modeling and simulation support for developing fault-tolerant future electric-grid communication infrastructure. The complete commissioning of this center is planned by 6/30/04.

13. **Project Changes:**
Under the current program there have been no changes in the project direction or timetable.

14. **Commercialization Potential, Plans, and Activities**:

This project aims at leveraging the use of intelligent integrated wireless sensors into the industries of future. Currently the vast majority of the process monitoring and control in the industries is done using wired sensors or tethered networks of devices. Utilization of advanced wireless telemetry in the industries will help reduce cost, improve efficiency and provide reliable links to the sensors. However, the wireless network deployment demands a quantifiable reliability, performance and security characterization from the end-user community. This project is developing the required test and verification methodologies and addresses the critical issues to assure the end-users of the performance of these devices and networks to help bring advanced wireless sensors and networks to the IOFs. Once demonstrated, the industry can more confidently accept intelligent wireless sensors as a practical, energy efficient and economic technology.

15. **Patents, Publications, Presentations:**

Patents: Continuing to facilitate deployment of previously patented hybrid spread spectrum Technology.

Publications/Presentations:

- Wayne Manges made an invited presentation at Lost Foam Casting Division Meeting in Birmingham, AL on 2/17.
- Stephen Smith gave an invited talk at the Industrial Wireless Applications Summit on 3/8/04 in San Diego supporting a WINA presence there.
- Teja Sastry gave an invited presentation outlining the EMC2 at the WINA general meeting on February 12 at Research Triangle Park, NC.
- Wayne Manges gave an invited presentation at the EPRI Wireless User's Group meeting in Washington, DC on May 10, 2004.
- Wayne Manges and Stephen Smith gave invited talks at the NNSA Technology Conference in Arlington, VA on May 17 and 18, 2004, respectively.

Phase / Budget Period			Approved Spending Plan			Actual Spent to Date		
			DOE Amount	Cost Share	Total	DOE Amount	Cost Share	Total
	From	To						
Year 1	10/03	09/04	$1,000K	$0	$1,000K	$732K	$0	$732K
Year 2								
Year 3								
Year 4								
Year 5								
Totals			$1,000K	$0	$1,000K	$732K	$0	$732K